## REMARKS

Claims 1-26 are currently pending in the application. By this amendment, claims 1 and 21 are amended and claims 22-26 are added for the Examiner's consideration. The above amendments do not add new matter to the application and are fully supported by the original disclosure. For example, support for the amendments is provided in the claims as originally filed, at Figures 6a-c, and at page 9 of the specification. Reconsideration of the rejected claims in view of the above amendments and the following remarks is respectfully requested.

### *Allowed Claims*

Applicants appreciate the indication that claim 15 contains allowable subject matter. However, Applicants submit that all of the claims are in condition for allowance for the following reasons.

### *35 U.S.C. §102 Rejection*

Claim 21 is rejected under 35 U.S.C. §102(b) as being anticipated by U.S. Patent No. 4,512,826 issued to Whang ("Whang"). This rejection is respectfully traversed.

A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference. *Verdegaal Bros. v. Union Oil Co. of California*, 814 F.2d 628, 631, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987). See MPEP §2131. Applicants submit that the applied art does not show each and every feature of the claimed invention.

Aspects of the present invention relate to a workpiece made from a titanium based alloy. More specifically, independent claim 21 has been amended to recite:

21. (currently amended) An alloy for producing a workpiece made from a titanium-based alloy, comprising elemental lanthanum combined with TiAl6V4, the alloy having a lanthanum content of 0.3 – 3 atomic%.

The Examiner asserts that Whang discloses a titanium alloy comprising a lanthanum content of 0.1 to 2.0 atomic percent. Notwithstanding, Applicants submit that Whang does not disclose that the alloy comprises elemental lanthanum combined with TiAl6V4, as recited in claim 21.

Instead, Whang discloses various titanium alloys having rare earth elements (e.g., La, Ce, etc.) added to the alloy. More specifically, Whang explicitly discloses that rare earth elements can be added to the following base alloys: Ti-Al, Ti-Al-Sn, and Ti-Al-Zr-Sn (col. 7, lines 28-30; see also, the compositions shown in FIGS. 3, 4 and 10-15). Whang does not, however, disclose rare earth elements added to TiAl6V4.

Furthermore, Whang does not disclose elemental lanthanum combined with TiAl6V4. In exemplary embodiments of the present invention, the inventive alloy is produced in a vacuum arc furnace when conventional TiAl6V4 alloy is used as prealloy and is introduced into the furnace together with elemental lanthanum as a block. Thus, in embodiments of the invention, the alloy comprises elemental lanthanum combined with TiAl6V4. In contrast, Whang is completely silent as to elemental lanthanum being introduced to TiAl6V4.

Therefore, Whang does not disclose a titanium-based alloy comprising elemental lanthanum combined with TiAl6V4 and having a lanthanum content of 0.3 – 3 atomic%, and cannot anticipate the invention recited in claim 21. Accordingly, Applicants respectfully request that the §102 rejection of claim 21 be withdrawn.

*35 U.S.C. §103 Rejection*

Claims 1-3, 5-8, 10-11, and 16 are rejected under 35 U.S.C. §103(a) for being unpatentable over U.S. Patent No. 4,415,375 issued to Lederich et al. ("Lederich") in view of U.S. Patent No. 2,892,742 issued to Zwicker et al. ("Zwicker") and U.S. Patent No. 1,360,358 issued to Beall ("Beall").

Claim 4 is rejected under 35 U.S.C. §103(a) for being unpatentable over Lederich and Zwicker, and further in view of and U.S. Patent No. 4,505,764 issued to Smickley et al. ("Smickley").

Claim 9 is rejected under 35 U.S.C. §103(a) for being unpatentable over Lederich and Zwicker, and further in view of and U.S. Patent No. 4,902,535 issued to Garg et al. ("Garg").

Claims 12-13 are rejected under 35 U.S.C. §103(a) for being unpatentable over Lederich and Zwicker, and further in view of and U.S. Patent No. 5,211,775 issued to Fisher et al. ("Fisher").

Claim 14 is rejected under 35 U.S.C. §103(a) for being unpatentable over Lederich and Zwicker, and Fisher, and further in view of and U.S. Patent No. 2,974,021 issued to Borowik ("Borowik").

Claims 17-20 are rejected under 35 U.S.C. §103(a) for being unpatentable over Lederich and Zwicker, and further in view of Whang. These rejections are respectfully traversed.

The examiner bears the initial burden of factually supporting any *prima facie* conclusion of obviousness. If the examiner does not produce a *prima facie* case, the applicant is under no obligation to submit evidence of nonobviousness. (MPEP §2142). To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of

ordinary skill in the art, to modify the reference or to combine reference teachings.[1] Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on applicant's disclosure. *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991). Applicants submit that no proper combination of the applied art teaches or suggests each and every feature of the claimed invention.

*Claims 1-3, 5-8, 10-11, and 16 in view of Lederich, Zwicker, and Beall*

As stated *supra*, the present invention relates to a method for machining a workpiece made from a titanium based alloy. More specifically, independent claim 1 recites:

> 1. A method for machining a workpiece made from a titanium-based alloy, comprising:
> a) heating of the workpiece in a hydrogen-containing atmosphere, wherein the workpiece takes up hydrogen;
> b) cooling of the workpiece;
> c) metal-removing machining of the workpiece; and
> d) heating of the workpiece in a hydrogen-free atmosphere, wherein hydrogen is released.

The Examiner asserts that Lederich discloses hydrogen charging a titanium alloy by heating a work piece in a hydrogen containing atmosphere. The Examiner further asserts that the work piece is then "formed in a die press (machined)" after which hydrogen is removed by heating the work piece in a vacuum. The Examiner acknowledges that Lederich does not disclose cooling of the workpiece, or metal-removing machining of the workpiece. The Examiner concludes,

[1] While the *KSR* court rejected a rigid application of the teaching, suggestion, or motivation ("TSM") test in an obviousness inquiry, the [Supreme] Court acknowledged the importance of identifying "a reason that would have prompted a person of ordinary skill in the relevant field to combine the elements in the way the claimed new invention does" in an obviousness determination. *Takeda Chemical Industries, Ltd. v. Alphapharm Pty., Ltd.*, 492 F.3d 1350, 1356-1357 (Fed. Cir. 2007) (quoting *KSR International Co. v. Teleflex Inc.*, 127 S.Ct. 1727, 1731 (2007)).

however, that a cooling step would be obvious in view of Lederich (the Examiner asserts natural cooling occurs as the workpiece is removed from the furnace and exposed to ambient atmosphere) or Zwicker (which the Examiner asserts discloses cooling after a hydrogen charging step but prior to hydrogen removal). The Examiner also concludes that it would have been obvious to remove excess metal from the work piece after die pressing, as taught by Beall. Applicants respectfully disagree and submit that no proper combination of the applied art renders the claimed invention unpatentable.

Applicants acknowledge Lederich discloses heating a Ti-6Al-4V alloy to add hydrogen, and subsequently heating the alloy in a vacuum to release the added hydrogen. However, Lederich does not disclose *cooling of the workpiece*, or *metal-removing machining of the workpiece*. Nor would it have been obvious to modify Lederich to include these steps.

*Lederich does not disclose cooling of the workpiece, and there is no reason to add a cooling step to the process of Lederich.*

Lederich discloses a method of superplastic forming of titanium alloys. Superplastic forming is known; however, Lederich teaches adding hydrogen to the alloy before the superplastic forming and releasing hydrogen from the alloy after the superplastic forming. More specifically, in each of the embodiments using titanium alloy, Lederich discloses: (i) heating the alloy to a first temperature in a pressurized atmosphere to add hydrogen; (ii) heating the alloy to a second temperature (higher than the first) to superplastic-form the alloy, and then (iii) heating the alloy to a third temperature in a vacuum to release hydrogen. Of particular note is the fact that the superplastic forming step (between the hydrogen charging and release steps) is performed at a temperature that is higher than both the hydrogen charging and release steps. Therefore, not only does Ledeirch fail to disclose cooling – Lederich, in fact, discloses the opposite: heating to an even higher temperature.

Thus, contrary to the Examiner's assertion, it does not follow from the teachings of Lederich that the alloy would be exposed to "natural cooling as it is removed from the furnace and exposed to ambient atmosphere". This is because the alloy is not removed from the die in which it is heated. Instead, Lederich teaches the alloy (referred to Lederich as "stock") is initially heated in a die to add hydrogen (col. 3, lines 40-43). Then, while remaining in the same die, the stock is heated to a higher temperature while the pressure on a first side is released and the pressure on a second side is increased (col. 3, lines 56-63). This causes the stock to "flow" into the complex shape of the die (e.g. superplastic forming). Thus, Lederich does not disclose that the stock is "removed from the furnace" as asserted by the Examiner. Instead, Lederich discloses the opposite, i.e., that the stock remains in the die after hydrogen charging, and is heated to an even higher temperature for the forming step.

Further contrary to the Examiner's assertions, it would not have been obvious to cool Lederich's stock after the hydrogen charging step, as allegedly taught by Zwicker. As discussed above, Lederich is directed to a method of superplastic forming, in which the stock is raised to an even higher temperature after the hydrogen charging step so that the stock can slowly flow into the complex shape of the die. Thus, not only does Lederich teach away from cooling, but adding a cooling step would render Lederich's process inoperable for its intended use. That is to say, cooling the stock (instead of heating it to a higher temperature) would cause it to harden, such that it could not flow into the die. For this exact reason, Lederich makes the temperature even higher in order to form the workpiece. Also, as the proposed modification would render the prior art invention unsatisfactory for its intended purpose, there is no suggestion or motivation to make the proposed modification. (See, *In re Gordon*, 733 F.2d 900, 221 USPQ 1125 (Fed. Cir. 1984); MPEP §2143.01.) Therefore, there is no logical reason to add a cooling step to Lederich, as proposed by the Examiner.

Applicants emphasize that the aim of Zwicker and Lederich is to improve the deformability of a workpiece, which is why they each disclose deforming a workpiece at a high temperature. In contrast, embodiments of the present invention aim to improve the machining of a workpiece made from TiAl6V4. The improved machining qualities of the workpiece allow higher cutting speeds to be achieved. Machining of a workpiece is generally performed at room temperature (it is unheard of, and likely impossible, to install a milling machine in an oven or furnace). Therefore, in embodiments of the invention the workpiece is cooled after the heating. More specifically, Applicants' specification states that "For cooling, the induction furnace is switched off and the workpiece is left to its own devices. When it has reached a temperature which allows further processing, the hydrogen-laden workpiece is subjected to metal-removing machining" (Specification, page 7). This cooling step in embodiments of the invention is in direct contrast to the HELP-Effect (Hydrogen-Enhanced-Local-Plasticity) utilized by Lederich and Zwicker, which requires temperatures above 200° C.

Moreover, Applicants submit that one having ordinary skill in the art at the time the invention was made would not look to Zwicker for guidance to modify Lederich's invention. Zwicker is directed to a method for hot-working of titanium alloys, not superplastic forming. Zwicker teaches in Example 1 (the passage identified by the Examiner) that a titanium alloy is melted to add hydrogen, and then allowed to solidify. After solidification, the alloy is heated again and hot-worked (e.g., impacted with a 400 kg forging hammer). The process of Zwicker is so different from that of Lederich that the skilled artisan would have no reason to combine the teachings of the two. For example, Lederich does not disclose melting the alloy and then allowing it to solidify to add hydrogen; instead, Lederich teaches heating the alloy (below the melting point) in a pressurized hydrogen-containing atmosphere. Also, Lederich does not disclose hot-working (e.g., impacting with a forging hammer); instead, Lederich discloses superplastic forming

in which the stock is heated to an elevated temperature and allowed to flow into a die shape. Therefore, the processes of Lederich and Zwicker are so different that one having ordinary skill in the art would not envisage a reason to combine the teachings of the two.

Beall does not cure the deficiencies of Lederich and Zwicker, because Beall also fails to disclose or teach cooling the workpiece. Instead, Beall only discloses die-pressing and machining, and makes no mention of heating or cooling.

*Lederich does not disclose metal-removing machining of the workpiece, and there is no reason to add such a step to the process of Lederich.*

As discussed *supra*, Lederich is directed to a method of superplastic forming. Superplastic forming does not comprise metal-removing machining of a workpiece. Instead, superplastic forming is a forming method that is typically employed when complex parts having complex shapes cannot readily be formed by standard casting, molding, or machining techniques (Lederich, lines 17-31 of col. 1). Thus, contrary to the Examiner's apparent understanding, the workpiece (e.g., stock) in Lederich is not "formed in a die press (machined)". Therefore, contrary to the Examiner's assertion, it would not have been obvious to "remove excess metal from the workpiece after the die pressing in the process of Lederich" because there is no die-pressing operation in Lederich.

Furthermore, Applicants submit the Examiner's proposed combination of the teachings of Lederich, Zwicker, and Beall is improper. It is true that Beall discloses removing excess metal from a gear by grinding or machining. However, the removing excess by grinding or machining is performed after a die-pressing operation, not after a superplastic forming operation (as in Lederich). As such, there is no identifiable reason for adding a metal-removing machining step to the process of Lederich.

For all of the above-noted reasons, Applicants submit that no proper combination of the applied art discloses or teaches all of the invention recited in claim 1. As claims 2, 3, 5-8, 10-11, and 16 depend from independent claim 1, these claims, too, are distinguishable from the applied art at least for the reasons discussed above. Moreover, the applied art fails to disclose or suggest many of the features recited in the dependent claims.

Claim 6

No proper combination of the applied art discloses or suggests the workpiece is cooled in the hydrogen-containing atmosphere, as recited in claim 6. The Examiner acknowledges that Lederich is silent as to a cooling step, but asserts that Zwicker teaches heating a workpiece in an oven containing hydrogen and allowed to cool in the same oven, and that it would have been obvious to modify Lederich to include this step based upon the teaching of Zwicker. Applicants disagree.

First, as discussed above, it would not have been obvious to add a cooling step to Lederich, since the superplastic forming requires the stock to be heated to a higher temperature after the hydrogen charging step. As it would not have been obvious to add a cooling step, it would not have been obvious to add a cooling step where workpiece is cooled in the hydrogen-containing atmosphere.

Second, contrary to the Examiner's assertion, Zwicker does not disclose or suggest a workpiece is cooled in a hydrogen-containing atmosphere. Zwicker discloses that a sample "was additionally heated to 900 °C in hydrogen and permitted to cool in the oven" (col. 2, lines 41-43). This passage only states that the sample was cooled in the oven, but does not describe the atmosphere of the oven during the cooling. There is no way to tell from this statement whether the oven contained hydrogen or not while the sample was allowed to cool. Therefore, no proper

combination of the applied art teaches the workpiece is cooled in the hydrogen-containing atmosphere, as recited in claim 6.

Claim 7

Claim 7 depends indirectly from independent claim 1, and additionally recites the vacuum is at least $2 \cdot 10^{-3}$ Pa. The Examiner admits that Lederich is silent regarding a quantitative value of the vacuum pressure, but asserts that the claimed invention would have been obvious in view of Zwicker's teaching of a "high vacuum". Applicants respectfully disagree.

Zwicker, like Lederich, fails to disclose or teach a quantitative value of the vacuum pressure. The phrase "high vacuum" is a relative term, and in no way teaches a vacuum of at least $2 \cdot 10^{-3}$ Pa. Therefore, the applied art fails to disclose or suggest each and every feature of the claimed invention.

Accordingly, Applicants respectfully request that the §103 rejection of claims 1-3, 5-8, 10-11, and 16 be withdrawn.

*Claims 4, 9, 12-14, and 17-20*

Claims 4, 9, 12-14, and 17-20 are rejected under 35 U.S.C. §103(a) as being unpatentable over Lederich and Zwicker, and further in view of various additional combinations using references: Smickley, Garg, Fisher, Borowik, and Whang. These rejections are respectfully traversed.

Claims 4, 9, 12-14, and 17-20 depend from allowable independent claim 1, and are allowable at least for the reasons discussed above with respect to claim 1. That is to say, Lederich and Zwicker (and Beall) fail to disclose or suggest the combination of features recited in claim 1, including *inter alia*: *cooling of the workpiece* and *metal-removing machining of the workpiece*. None of the other applied references (e.g., Smickley, Garg, Fisher, Borowik, and Whang) cure the

deficiencies of Lederich and Zwicker (and Beall) with respect to independent claim 1, because none of these references teach *cooling of the workpiece* and *metal-removing machining of the workpiece*. Therefore, no proper combination of the applied art discloses or suggests all of the features of independent claim 1, and claims 4, 9, 12-14, and 17-20 that depend therefrom.

Accordingly, Applicants respectfully request that the §103 rejection of claims 4, 9, 12-14, and 17-20 be withdrawn.

*New claims*

New claims 22-26 are added by this amendment, and are believed to be distinguishable from the applied art for at least the following reasons. Claims 22 and 25 recite *the lanthanum content is above 2 atomic%*. Explicit support for this feature is found at lines 32-33 of page 9 of Applicants' specification. None of the applied art documents discloses this feature. More specifically, Whang teaches a rare earth content in the range of 0.1 atomic% to 2 atomic%, which does not constitute a lanthanum content <u>above</u> 2 atomic%. In fact, Whang expressly teaches away from the recited atomic %, stating "[i]f too large amounts of rare earth elements are utilized, some of the rare earth element does not dissolve which accelerates particle coarsening at high temperatures and makes the corresponding alloy brittle" (col. 3, lines 48-52).

Claim 23 depends from allowable claim 21, and additionally recites the alloy is a $\alpha + \beta$ alloy. Whang fails to disclose an $\alpha + \beta$ alloy, but rather only discloses "$\alpha$ or near $\alpha$" alloys.

Claim 24 depends from allowable claim 21, and additionally recites the alloy includes precipitates having a mean size of greater than 2 μm. Such particle sizes are disclosed, for example, at Applicants' FIGS. 6A-C. Whang does not disclose precipitates of this size. Instead, Whang discloses that precipitates with diameters ranging from 50 to 100 Angstroms (col. 3, lines

63-65). In fact, Whang expressly teaches against having particles sizes larger than 0.1 μm (col. 3, lines 65-68).

New independent claim 26 is added by this amendment and is substantially directed to the subject matter of original claims 1, 8 and 12. Therefore, claim 26 is allowable at least for the same reasons discussed above with respect to claim 1. Moreover, Applicants submit that no proper combination of the applied art teaches or suggests the features of claim 1 in combination with: removing at least one of surface oxides and further covering layers from the workpiece, and heating the workpiece in a hydrogen-containing atmosphere to a temperature of at least 773 K, wherein the workpiece takes up hydrogen.

## CONCLUSION

In view of the foregoing amendments and remarks, Applicants submit that all of the claims are patentably distinct from the prior art of record and are in condition for allowance. The Examiner is respectfully requested to pass the above application to issue. The Examiner is invited to contact the undersigned at the telephone number listed below, if needed. Applicants hereby make a written conditional petition for extension of time, if required. Please charge any deficiencies in fees and credit any overpayment of fees to Attorney's Deposit Account No. 19-0089.

Respectfully submitted,
Joachim ROESLER

Andrew M. Calderon
Reg. No. 38,093

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GREENBLUM & BERNSTEIN, P.L.C.
1950 Roland Clarke Place
Reston, VA 20191
(703) 716-1191